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EXPERIMENTAL HARVEST OF THE STELLER SEA LION IN ALASKAN WATERS

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FISH AND WILDLIFE SERVICE

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and
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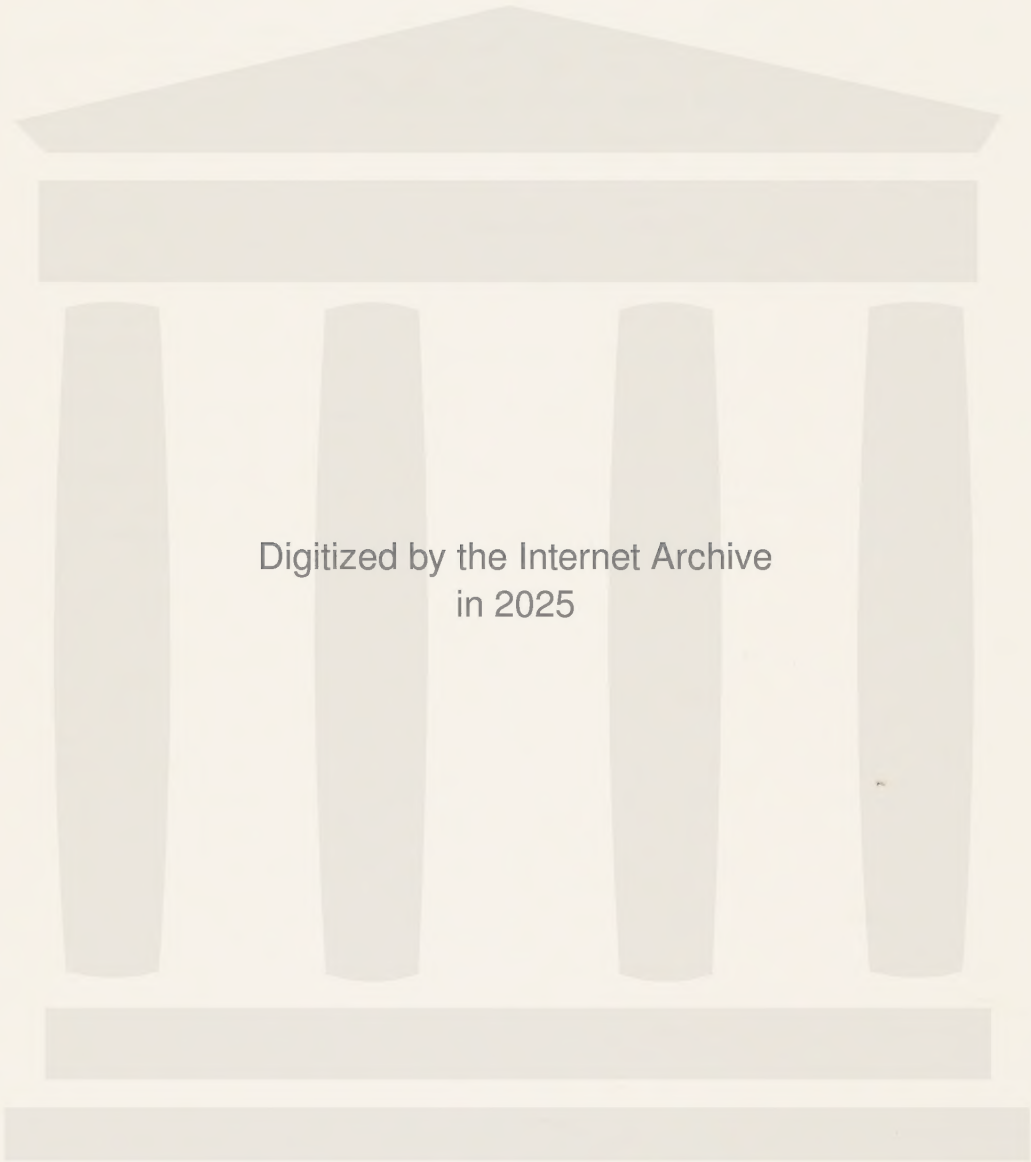

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by

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ABSTRACT

During the summer of 1959, a commercial fishing company, under contract to the Bureau of Commercial Fisheries, conducted an experimental harvest of the Steller sea lion *(Eumetopias jubata)* in Alaska. During the expedition, 616 sea lions were killed of which 464 were ultimately processed. The yield was 200 tons of ground meat and 9 tons of whole livers, which was packaged in 50-pound bags, frozen, and sold through established commercial channels to fur farmers for feeding mink.

INTRODUCTION

The Steller sea lion *(Eumetopias jubata)* has been widely condemned by the fishing industry. Salmon, halibut, and herring fishermen have been unanimous in their complaints about depredations by this mammal. The persistence and uniformity of the complaints and concern over the declining salmon pack in Alaska have led to recent intensive study of the Steller sea lions and their effects on the fisheries. The Alaska Department of Fish and Game and the Fisheries Research Institute of the University of Washington, through contracts with the Bureau of Commercial Fisheries, have conducted studies of the biology of sea lions and have carried out surveys to study population size, distribution, and seasonal shifts in abundance. Mathisen (1958) estimates there are at least 150,000 sea lions in Alaskan waters, most of which are found on rookeries located along the Alaska Peninsula and the Aleutian Islands. Individual rookery counts vary from 25 to 15,000 animals.

The two agencies making the studies circulated questionnaires throughout the fishing industry to document the time, location, and nature of damage done by sea lions. Returns from these questionnaires indicate that salmon fishermen do suffer an economic loss from sea lion activities, both in damage to gear and by loss of fish taken from the gear (Alaska Department of Fish and Game, 1957).

Halibut fishermen report that at times sea lions damage or remove so many fish from their gear that it is not profitable to remain on the halibut banks. A sample poll of halibut vessels by the International Pacific Halibut Commission in 1958 brought out that an estimated 1.3 million pounds of halibut were damaged or destroyed on the

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grounds between Cape Saint Elias and the Trinity Islands in the Gulf of Alaska. At dockside prices this amount of halibut is worth approximately $270,000 (preliminary statement issued at the annual meeting of the International Pacific Halibut Commission, January 1959). As one result of the poll, the International Pacific Halibut Commission has required that all fishermen record depredation in the logbooks that they keep for the Commission.

Stomach analyses reported in the literature (Pike, 1958; Mathisen, 1958) indicate that the diet of sea lions is varied and that no significant numbers of commercially important species are taken. However, most of the stomach samples were taken from sea lions on rookeries during the breeding season, and they may not reflect completely the food habits of sea lions. Food habits during other seasons of the year are unknown. Recent evidence obtained by the Fisheries Research Institute during a high seas tagging program in the North Pacific and Bering Sea points to possible open-sea predation on salmon by sea lions (Mathisen, 1958). At present it appears that, except when they are in contact with an active fishery, sea lions take insignificant quantities of commercial species with the possible exception of salmon.

The depredations of sea lions in the vicinity of active fisheries are serious because they cause measurable economic losses by damaging fish and gear and intangible economic losses by reducing fishing time or frightening fish away from the gear. Control measures should be applied in critical areas. Programs of complete destruction of herds have been attempted in the past and have met rightly deserved criticism and opposition from conservationists throughout the nation. Bounty programs were attempted but have been abandoned. Reduction of a herd by a bounty system is expensive and unwieldy and may fail to correct the situation, because kills may not be made at the proper place or time or in adequate numbers.

A practical approach to the problem of control may lie in commercial exploitation of these mammals. Dassow (1956) and Kyte (1956) investigated possibilities of utilizing sea lions and found that both lean meat and liver were high in protein and low in oil content. The protein content was similar to horse meat and lean whale meat, both of which are used extensively in animal feeds. There is a demand for an economical meat, with high-protein and low-fat content, for use as either fur farm or fish hatchery feed in the midwestern and western states. Pilot studies involving harvesting techniques and handling of sea lions conducted on Chernabura, one of the Shumagin Islands, by the Fisheries Research Institute through a contract with the Bureau of Commercial Fisheries, indicates that sea lions might be taken from rookeries in commercial quantities (Baade, et al.)[2] As a result, the Bureau of Commercial Fisheries awarded a contract in the spring of 1959 to a commercial fishing company, Arctic Maid Fisheries, Inc., to develop techniques for harvesting sea lions on rookeries in Alaskan waters and to investigate markets for commercial utilization. The company operates a freezership, the motor vessel *Arctic Maid*, which served as mothership and base for the operation (fig. 1). It is the purpose of this report to present the results of this investigation.

THE EXPERIMENTAL HARVEST

Equipment and Facilities of the *Arctic Maid*

The *Arctic Maid*, a diesel-electric ship of 960 gross tons, is 186 feet in length and has a 39-foot beam. Power to the ship's single screw is furnished by twin 900-hp. diesel engines that deliver 1,500 horsepower to the propeller shaft. Two 75-kw diesel generators supply electric power to the ship's equipment.

The ship has two 5-ton-capacity electric cargo winches, located forward and aft, which were used to hoist animals aboard and to lower processed meat into the hold (fig. 2).

[2] Baade, Robert T., Ole A. Mathisen, and Ron J. Lopp. In press. Studies on the Steller sea lion *(Eumetopias jubata)* on Chernabura Island in the Shumagin area of Alaska during the summer of 1958.

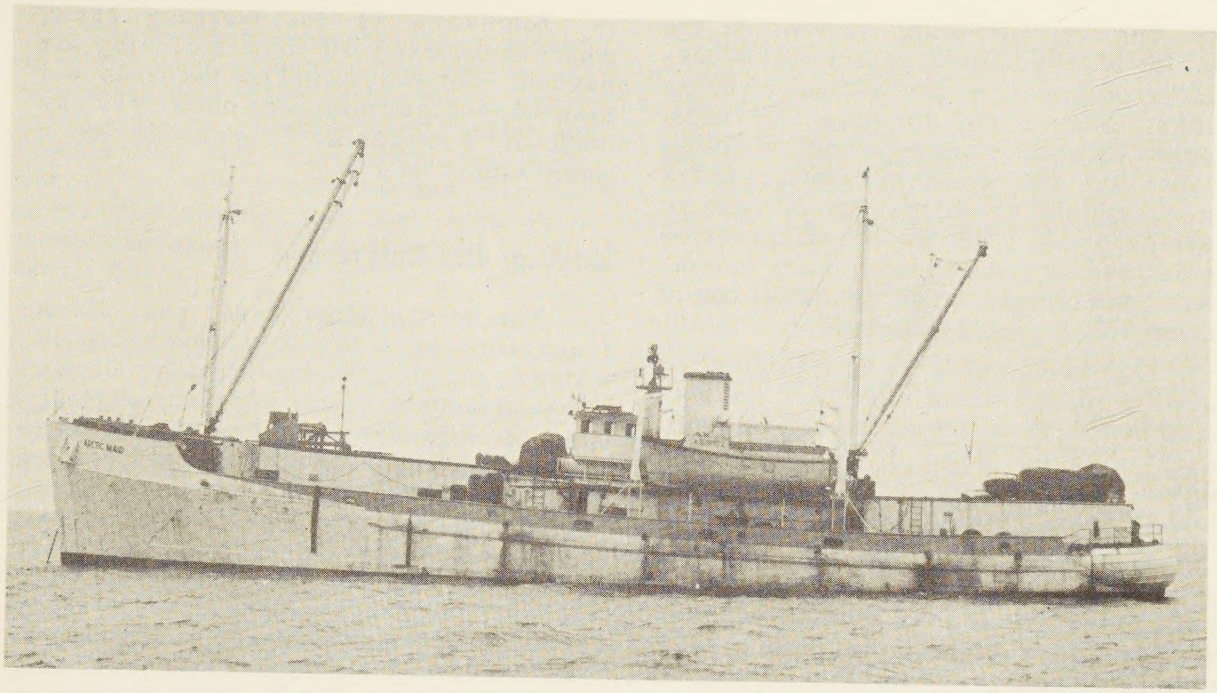

Figure 1.--*Arctic Maid*, mothership used in harvesting sea lions.

Figure 2.--Sea lions being hoisted aboard ship.

The refrigeration system of the *Arctic Maid* consists of six 6,000-gallon brine tanks, four 8,000-gallon brine tanks, and a 600-ton-capacity hold, cooled by absorption type coils. Cooling plants are two ammonia compressors each capable of delivering 70 tons of refrigeration. (One ton of refrigeration is defined as cooling necessary to convert 1 ton of water at 32° F. into 1 ton of ice at 32° F. per 24 hours.)

The processing area was located forward on the brine tank deck and was equipped with a boning table, a 15-hp. meat grinder with 3/4-inch cutting plates, a conveyor worm, and a metal hopper from which meat was sacked.

The ship carried two 31-foot Bristol Bay-type gill net boats which were used to shuttle hunting parties to the beach and to transport dead animals. They were also used to pull dead animals from the beach into the water.

Members of the working crew, which numbered 10 men including the captain, not only worked the ship but also served as hunters or butchers. The cook and 3 engineers brought the ship's complement to 14.

Hunting and Retrieving

The *Arctic Maid* took sea lions from five of the many rookeries in waters of the North Pacific Ocean between Kodiak Island and Unimak Pass (fig. 3). The first rookery visited was Marmot Island, northeast of Kodiak Island, where 2 weeks were spent in developing hunting and processing techniques. The methods evolved at Marmot Island were employed during the remainder of the season. None of the crew had previous experience in meat processing. At first they made themselves available as the work dictated, but soon each man had a specific job.

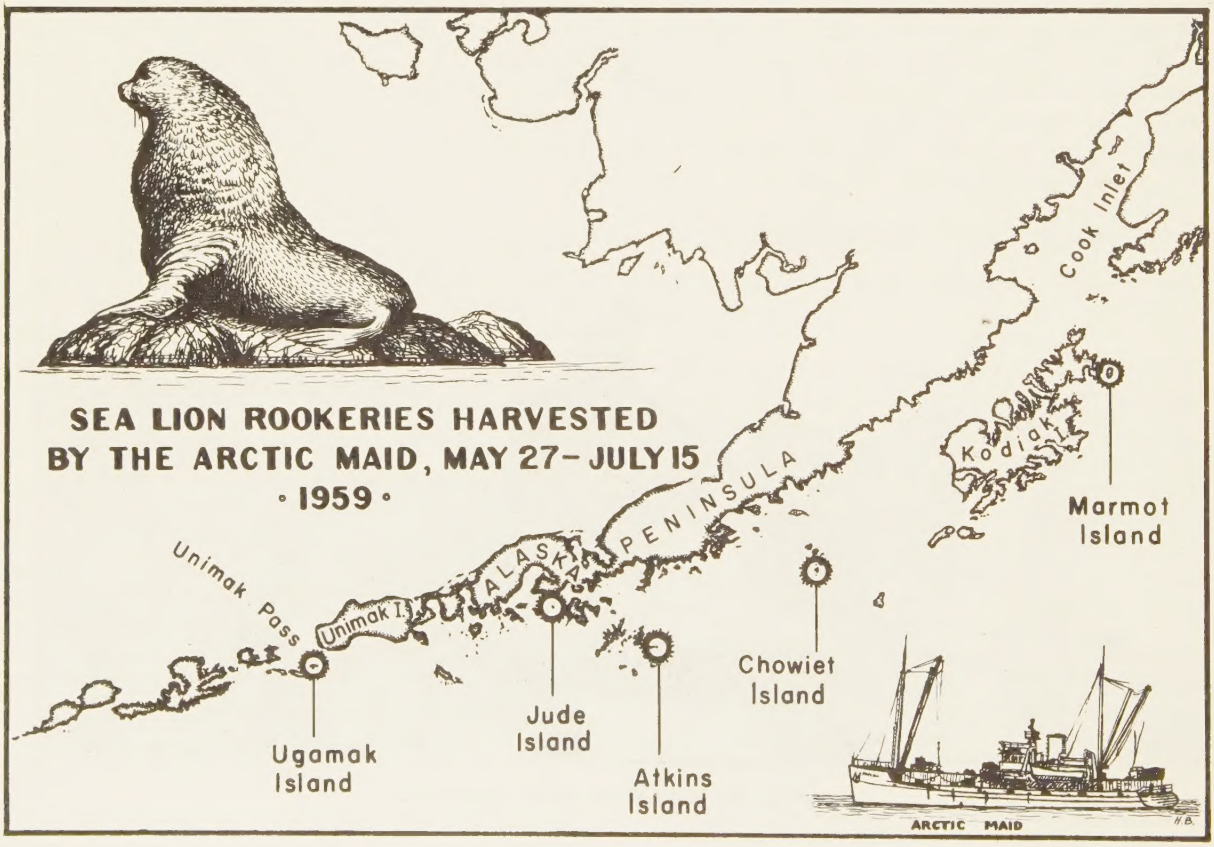

Figure 3.--Sea lion rookeries harvested by the *Arctic Maid*, 1959.

The hunting party usually consisted of three or four men. One of the gill net boats was used to carry the party to the beach, and a small skiff or rubber life raft was used to land them ashore at the fringe of the harvest area. The rubber raft was used when surf conditions precluded use of the small boat.

Sea lions were shot at fairly close range with 30.06-caliber sporting rifles equipped with open sights. Military ammunition (ordinary 30.06-caliber service ammunition, full jacketed "ball") was used and served satisfactorily. Judgment was required in selecting animals for shooting. Those shot near the edge of the water, if not killed outright, managed to get into the water and were lost. It is extremely difficult to retrieve carcasses of animals killed too far from the water, since adult males weigh up to 2,200 pounds and females up to 1,000 pounds (Kenyon and Scheffer, 1953). Killing ceased when enough animals, usually about 15, were down to supply a day's work in processing.

Manila or wire rope chokers placed through slots cut in the neck hide were secured to a hauling line attached to the gill net boat. Animals were then pulled from the beach into the water by the boat. Once in the water the carcasses were easily pulled to the boat--either hand over hand or by using a winch. The hauling line was then freed and passed ashore again, and the chokers were used to secure the animals to the gunwale of the gill net boat for transport to the *Arctic Maid*.

Reactions of Sea Lions to Hunting

The reactions of sea lions to harassment were similar in pattern on all of the rookeries hunted. Variations were a matter of the degree to which the animals reacted. This, in turn, was dependent upon the stage of the breeding season. Bulls and cows were least wary at the height of the breeding season.

The hunting party usually landed to one side of the group of sea lions to be hunted, out of sight if possible. Landing disturbed only nearby animals. Animals exhibited only slight alarm over the gill net boat when it was operated within 80 to 100 yards of the beach.

At the first shots, most animals showed considerable fright and many bolted toward the water. The first rush to the water comprised females without pups, young animals, and bachelor bulls. Harem bulls and cows with newborn pups were extremely reluctant to leave and either did not move at all or stopped their flight short of the water's edge. Continued fire forced these animals into the water where they milled slightly offshore and showed a strong tendency to return. While in the water the animals displayed great interest in the activities on the beach but relatively little interest in the boat or skiff which was often nearer at hand. Sea lions became increasingly wary and frightened more readily after successive days of shooting. At the first volley of shots, all but the most stubborn bulls and cows rushed immediately to the water. Beaches were quickly cleared when additional shots were fired.

Continued hunting over the same area caused an emigration to nearby rocks or a lateral movement along the beach if space was available. Emigration began after 3 to 5 days of hunting. It was not a mass movement but was observed as a perceptible thinning in the ranks of sea lions each day. Young animals were the first to move. The pups either moved away because of fright or were herded by the females.

Harem bulls that were killed were replaced by idle or bachelor bulls very quickly. Mathisen (1958) reports that on Chernabura Island harem bulls were replaced within less than 30 minutes after their death and frequently within 10 minutes. A striking example of this replacement occurred on the Ugamak Island rookery in Unimak Pass. One area of this rookery was hunted intensively for 9 days. On the first day of the hunt, 25 bulls and approximately

300 cows occupied the area, and many idle bulls were observed on adjacent rocks and beaches from 300 yards to a mile away. A total of 156 bulls were killed, an average of 17 per day. An additional 12 were wounded. The speed of replacement is unknown, but it occurred overnight.

The rookeries visited and the results of the harvest are summarized in table 1.

Table 1. -- Summary of experimental sea lion harvest

Location (Island)	May 27-June 10 Marmot	June 12-June 24 Atkins	June 26-July 8 Ugamak	July 10-July 11 Jude	July 13-July 14 Atkins	July 15 Chowiet	Total
Total days of hunting	14	14	12	2	2	1	45
Days lost because of weather	5	2	2	0	0	0	9
Days operated	9	12	10	2	2	1	36
Number animals killed or wounded	137	228	179	39	37	10	630
Number animals processed	78	162	152	31	32	9	464
Yield (pounds)							
Bone-free meat							
Total	31,700	65,700	69,850	12,650	11,350	3,300	194,550
Average per animal	406.4	405.6	459.5	408.1	354.7	366.7	419.3
Liver							
Total	3,000	6,500	6,150	1,100	1,050	300	18,100
Average per animal	38.5	40.1	40.5	35.5	33.9	44.4	39.0
Man hours expended in obtaining and processing animals							
Total	782	861	689	176	168	70	2,746
Average per animal	10.2	5.3	4.5	5.7	5.3	7.7	5.9

Processing

Hunting was usually discontinued after approximately eight animals had been retrieved. The hunting party then returned to the *Arctic Maid* to unload the animals. Usually two trips were made to the rookeries each day.

The animals were hoisted aboard the *Arctic Maid* with the cargo winches. They were placed at two work areas on the forward and after decks over the brine tanks. Here they were prepared for skinning. First, the foreflippers were removed. Then the hide was split dorsally and ventrally and peeled back from the neck (fig. 4). The inner surface of the upper foreflipper was split to prevent binding during skinning. The carcass was then reslung on the winch and lowered to the main deck where skinning was completed.

Skinning was accomplished by pulling the carcass away from the hide. Hooks fastened to the main deck were attached to one side of the hide at the neckline. The carcass was then lifted by the winch, thus pulling it from the hide (fig. 5). The same operation was repeated to remove the other side of the hide. Most of the blubber came off with the hide, and the remainder was trimmed off with knives.

As soon as skinning was completed, the liver and the shoulders were removed. Next, the meat was trimmed from the carcass. This was

Figure 4.--Sea lion prepared for skinning.

Figure 5.--Deck hooks inserted into hide at neckline allow ship's gear to pull carcass away from hide.

done, starting from the neck, by cutting around the carcass as close to the bone as possible down the length of the carcass (fig. 6). This resulted in a blanket of bone-free meat. After flensing, the carcass was dropped overboard (fig. 7). The meat, along with the shoulders and livers, was placed on the deck of the ship to cool overnight.

The internal temperature of the sea lions at the time they were processed ranged from 99° to 102° F. Since the night air temperature averaged 46° F, the meat was cooled to between 50° and 60° F.

On the morning after the butchering, the shoulders were boned and all of the meat was ground in a 15-hp. grinder through a 3/4-inch plate (fig. 8). The ground meat was carried by an auger-type conveyor into a hopper. From the hopper the meat was passed through an adjustable door into polyethylene bags (fig. 9). The bags were rested on a scale and each one was filled to 50 pounds. A wood frame was used on the scale to keep the bags from tipping during filling. The bags were fastened shut with wire staples. The livers were packaged in the same manner, except that they were not

Figure 6.--Trimming meat from sea lion carcass.

Figure 7.--Carcass, after flensing, ready to be dropped overboard.

ground but were packaged whole or in large pieces.

The bags of meat and liver were laid out individually on the freezer hold deck to freeze before being stacked for storage (fig. 10). Temperature of the meat at the time it went into cold storage was between 50° and 55° F. Hold temperatures were usually maintained at 0° to 5° F. but, on some occasions, temperature reached as high as 10° F. for periods of as long as a day. It was found that 10 to 20 hours were required to bring the temperature of the bags of meat to 30° F. and approximately 3 days to completely freeze them.

The average yield of meat per animal was 419 pounds and the average yield of liver was 39 pounds (table 1). However, the average weight of 84 whole livers that were weighed individually was 48 pounds. The liver weights ranged from 15 to 80 pounds. Frequently during butchering only part of the liver was recovered. This accounts for the difference in the yield of 39 pounds of liver per animal and the average of 48 pounds for the livers weighed individually. Also, blood drained from the livers while they were being cooled caused additional weight loss.

Figure 8.--Grinder for sea lion meat.

Figure 9.--Crew members packaging ground sea lion meat.

Figure 10.--Bags of sea lion meat in hold for freezing.

Early in the season it was found that two to three times as much meat could be obtained from male sea lions as from females for about the same expenditure of time. As a result, far more males than females were killed, 452 males and only 12 females being ultimately processed.

Hides were saved and frozen on two occasions. The raw hides were generally poor in quality because of wounds and scars from fighting. Only 20 hides (40 sections) were saved. Four whole skinned carcasses were also saved and frozen.

Proximate Analysis of Ground Sea Lion Meat

Samples of ground sea lion meat were collected at various times and placed in cold storage for later use in determining the proximate analysis of the meat. The samples were collected during the packaging operations by taking small amounts of the ground meat at random as it passed from the hopper into the polyethylene bags used for packaging. Three 5-pound samples were collected whenever sampling was done.

The proximate analyses were completed by the Ketchikan Technological Laboratory, Bureau of Commercial Fisheries, Ketchikan, Alaska. Duplicate determinations were made of each 5-pound sample.

The results of the analyses are presented in table 2. The ground sea lion meat was quite uniform in composition. The moisture content of the meat ranged from 71.6 to 75.5 percent and averaged 73.6 percent. The oil content ranged from 3.4 to 7.7 percent and averaged 5.0 percent. The protein content ranged from 18.4 to 21.8 percent and averaged 20.4 percent. The ash content ranged from 1.0 to 1.3 percent and averaged 1.1 percent. These values do not include the sample taken on June 11, as it was composed of shoulder meat only. The shoulders were removed from animals killed on June 7 and 8. They were held in refrigerated sea water at 32° F. until

Table 2. -- Proximate composition (in percent) of ground sea lion meat determined by the method used by the Association of Official Agricultural Chemists

Date and location of sample	Number of animals[1/]	Moisture		Oil		Protein		Ash	
		Range	Av.	Range	Av.	Range	Av.	Range	Av.
Marmot Island									
June 6	10	74.1-74.7	74.4	4.5-4.8	4.6	19.7-20.4	20.1	1.2-1.2	1.2
8	12	73.4-74.5	74.1	3.7-4.8	4.1	20.7-21.4	21.1	1.1-1.2	1.1
10	10	71.7-72.9	72.4	4.9-6.9	5.8	20.7-21.6	21.1	1.1-1.2	1.2
11	2/27	75.8-77.5	76.8	2.4-4.6	3.2	18.2-18.9	18.6	1.6-1.7	1.6
Atkins Island									
June 13	10	71.6-74.0	72.6	4.9-7.7	6.3	19.3-21.4	20.4	1.1-1.2	1.1
14	16	74.3-75.5	74.8	4.0-5.1	4.5	20.1-20.6	20.3	1.2-1.3	1.2
15	9	72.3-74.7	73.8	4.0-7.1	5.7	18.4-19.9	19.0	1.0-1.1	1.0
18	13	73.6-74.6	73.9	3.9-4.8	4.3	20.3-21.8	20.9	1.1-1.2	1.2
19	18	73.4-74.7	74.0	3.4-5.4	4.4	20.8-21.7	21.1	1.1-1.2	1.1
20	12	73.0-74.5	73.8	4.5-5.4	4.9	19.4-20.3	19.8	1.1-1.2	1.2

1/ Indicates the number of carcasses being processed at the time the sample was taken. The meat from all of these was combined during processing.

2/ Shoulder meat only. The shoulders were removed from 12 carcasses on June 7 and from 15 carcasses on June 8, and were held in refrigerated sea water at 32° F. until June 11. Then the meat was trimmed from the shoulders, ground, and packaged.

June 11 when the meat was trimmed off, ground, and packaged. The higher moisture content of this meat compared with the other samples in table 2 indicates that water was picked up by the meat during the immersion in sea water. The high ash content indicates that salt was absorbed from the sea water.

Disposition of Sea Lion Meat

With the exception of a small portion retained for experimental purposes, all the sea lion meat and liver packaged was sold to fur farmers in the Pacific Northwest for use as mink food. The frozen, ground meat was sold through a commercial distributor for 10 cents a pound; livers 12 cents. Three frozen carcasses were sold for 7 cents a pound.

The meat might also be marketed for use in zoos, as pet foods, and perhaps in fish culture. These uses would be dependent upon tests for nutritional value and palatability and an assured stable supply of the raw product.

DISCUSSION

Surveys conducted by the Fisheries Research Institute and the Alaska Department of Fish and Game indicate that the numbers of sea lions in Alaskan waters are great enough to support a commercial operation. The *Arctic Maid* expedition experienced no difficulty in killing, in retrieving animals from the beach, or in transporting them to the mothership. From the standpoint of availability of the raw product, and providing that facilities for processing can be improved, the potential for a commercial operation is high.

The production of sea lion meat by the *Arctic Maid* expedition was limited by processing problems. The major limiting factor was butchering. The large size of the carcasses made

it necessary to handle them with the ship's cargo winches. Therefore, only two carcasses could be butchered at any one time. Skinning was not difficult once the method was developed and the crew had become experienced. Trimming the meat from the carcasses, particularly the shoulders, required more time than any other phase of the operation.

Any future attempt at harvesting sea lions should make use of specialized equipment to reduce the amount of labor required to process the carcasses. Some method of handling more than two carcasses at once would be needed. This could be done by using an overhead conveyor from which a number of carcasses could be suspended. It would be difficult to eliminate hand trimming to remove the meat from the carcasses and shoulders, but the use of time-saving devices such as conveyors would allow more time for trimming.

The method used to cool meat aboard the *Arctic Maid* would not be satisfactory for a larger operation. First, spreading meat on the deck to cool would not be practical because space would be insufficient. Second, to cool the meat by spreading it on the ship's deck, it was necessary to leave it on the deck over night. An alternate method of chilling was tried in which carcasses were allowed to hang in the water from the gunwale of the ship. This method was abandoned because the fat absorbed water and formed a sticky jell which made trimming difficult.

Considerable time could be saved if meat were cooled in a tank of circulating sea water, or ground warm and cooled in a hopper containing a series of vertical refrigerated plates. In either case, the meat could be dropped on a conveyor belt by the butchers and conveyed to a chilling tank or to the grinder.

The 15-hp. grinder used on the *Arctic Maid* was satisfactory for grinding meat only. It was capable of grinding much larger volumes than the 2 to 3 tons per day produced by the experimental harvest. If bones were to be included, a larger grinder would be needed.

The polyethylene bags used to package the ground meat were satisfactory for handling prior to freezing, but they tore easily when the frozen meat was handled. This permitted air to circulate freely around the meat causing some dehydration and oxidation. Double-wall paper bags with the inner surface coated with polyethylene were also tried. These bags tore easily during handling prior to freezing, especially if the outside of the bag became wet. A sturdier bag would be desirable in any future sea lion processing operation. There are a number of bags available, such as a burlap-polyethylene combination or a multiwall water-resistant paper bag containing one asphalt paper layer.

Staples which were used to close most of the bags of meat were inefficient because of the time required to hand staple each bag with five or six staples. An unsuccessful attempt was made to use a heat sealing machine to seal the polyethylene bags. The machine usually overheated the thin polyethylene, causing it to shrink considerably in some areas, while in others it did not seal at all. A machine for stapling or sewing the bags would save considerable time. With the water-resistant multiwall or the burlap-polyethylene bags, machine attached wire ties could be used.

The rate of freezing the 50-pound bags of ground meat aboard the *Arctic Maid* was slow. Approximately 3 days were required to freeze them completely. Any future operation would require a blast freezer or a plate freezer for quick freezing the meat.

The yield of meat per animal was low because a considerable amount of meat was left on the discarded carcass. Under the circumstances this waste was unavoidable. The amount of time required to trim all of the meat from the backbone and between the ribs was too great to justify doing so.

The yield would have been increased considerably if the rib cage could have been ground along with the meat. In addition, the heart, lungs, kidneys, and spleen could have been included with the meat. These organs alone would have increased the yield per animal by approximately 50 pounds.

Sea lion liver has little value as a source of vitamin A. Analysis of core samples taken from 30 bags of frozen livers showed the vitamin A content to be 13,550 units per gram of oil or 249,500 units per pound of liver.[3] The livers are satisfactory for mink rations.

The hides are of little value because of: (1) scars and bruises the animals incur naturally and during handling; (2) cost of curing which ranges between 30 and 35 cents per square foot; and (3) poor appearance of the grain, which precludes commercial acceptance.[4] Perhaps a portion of the hide could be used by the souvenir industry in Alaska. For instance, the leather from the flippers might be used for items such as billfolds, and teeth could be used for making souvenirs.

The portion of the carcass remaining after the meat has been trimmed off, including the blubber, could be used for meal and oil.

There are other factors, aside from technological or economical considerations that might affect the success of future expeditions. Sea lions habitually choose remote and relatively inaccessible islands as rookery sites. The great majority of Alaska's rookeries are located in the waters of the North Pacific, an area of frequent storms. Stormy weather and its secondary effect of surf might cause the loss of many days' operations. Weather conditions along the Alaska Peninsula and the Aleutian Chain were exceptionally good during the spring and early summer of 1959 and did not seriously hamper the *Arctic Maid*; even so, 9 days were lost during her 2-month cruise because of weather. However, weather is always an overlying risk in any deep-sea fishing operation and must be considered a normal hazard.

The cumulative effects of harvesting sea lion herds are, of course, unknown. If harvesting continues on an annual basis, it is certain to produce lasting changes in herd structure, abundance, and perhaps distribution. Studies carried out by the Alaska Department of Fish and Game and the Fisheries Research Institute have provided excellent information on present distribution and abundance. Information on behavior, reproduction, and other phases of life history has been obtained, but is based on only a few observations and specimens.

Seasonal shifts in abundance do occur. The greatest numbers of animals are found on the rookeries during the pupping and breeding seasons, mid-May through mid-July (Mathisen, 1958). Continued harassment at this time may force emigration from established rookeries to even more remote and inaccessible sites. Movement out of hunted areas, laterally along the beach or to nearby rocks, was observed on all rookeries during the course of the experimental harvest after 3 to 5 days' hunting.

The *Arctic Maid* harvest consisted almost entirely of males, because their large size made them commercially more attractive than the smaller females. Cropping only males will not affect herd productivity for a number of years or as long as there is a surplus of breeding males. This is inherent in the social structure of sea lion herds. Breeding bulls maintain loosely organized harems. Mathisen (1958) states that the size of an individual harem does not remain fixed; a bull noted to have 30 cows one day might have 10 the next day and possibly 35 the third day. Similarly, the

[3] Analysis completed by a commercial testing laboratory.

[4] Personal communication between Albert D. Levy, Washington Fish and Oyster Company of California, and Poetch and Peterson, San Francisco, California.

number of idle bulls is a changing figure. Since harem bulls that are killed are quickly replaced by idle bulls, a great number of bulls would have to be removed before the production of a herd would be affected. Controlling sea lion numbers or reducing a herd size by cropping only males would be a slow process. There would be no sharp decrease in sea lion activities on the fishing grounds. If reduction of the numbers of sea lions is an urgent and overriding consideration, then more females must be killed. If sea lions can be successfully exploited, it may later become necessary to regulate the harvest to preserve the resource.

Sea lion harvesting should take place during the pupping and breeding season when the animals are most available and least wary. On large rookeries specific areas should be hunted alternately for a greater yield. On a hunt-rest basis animals would not vacate an area quickly and would therefore be available for a long period of time.

If utilization of sea lion herds should prove a commercial success, the situation will be unique in having information available for management during the initial stages of exploitation. Observations of herd structure, behavior, and life history should continue and be concomitant with commercial development of this resource.

SUMMARY

A commercial fishing company, under contract with the Bureau of Commercial Fisheries, conducted an experimental harvest of Steller sea lions in Alaskan waters. The purpose of the experiment was to determine whether sea lions could be harvested, processed, and marketed in sufficient quantity to make a commercial venture practical as a means of decreasing the size of sea lion herds.

The problems encountered by the sea lion expedition were numerous. One of the main objectives was accomplished when it was found that sea lions could be taken in sufficient numbers to make a harvest possible. Processing problems kept production down, but the use of specialized equipment would overcome these.

The *Arctic Maid* harvested sea lions from five rookeries in the North Pacific Ocean between Kodiak Island and Unimak Pass in the period from May 27 to July 15, 1959. During the expedition 616 sea lions were killed, of which 464 were ultimately processed. The yield was approximately 200 tons of ground sea lion meat and 9 tons of whole livers. The sea lion products were frozen and packaged in 50-pound bags. With the exception of a small portion retained for experimental purposes, the entire amount of meat and livers was distributed and sold through commercial channels to fur farmers for use in mink rations. The meat was sold at the rate of 10 cents a pound, the livers at 12 cents a pound. Possibilities for other markets exist, but these are dependent on a stable annual harvest.

It is strongly advised that anyone interested in engaging in a sea lion fishery in Alaskan waters check with Federal and Alaskan State fishery regulations.

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